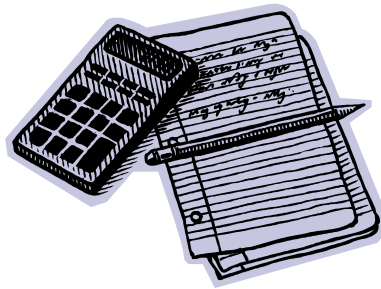


Academic Support Center

Using the TI 83/84+ Graphing Calculator



Designed and Prepared by
The Academic Support Center
Revised June 2008

Using the Graphing Calculator (TI-83+ or TI-84+)

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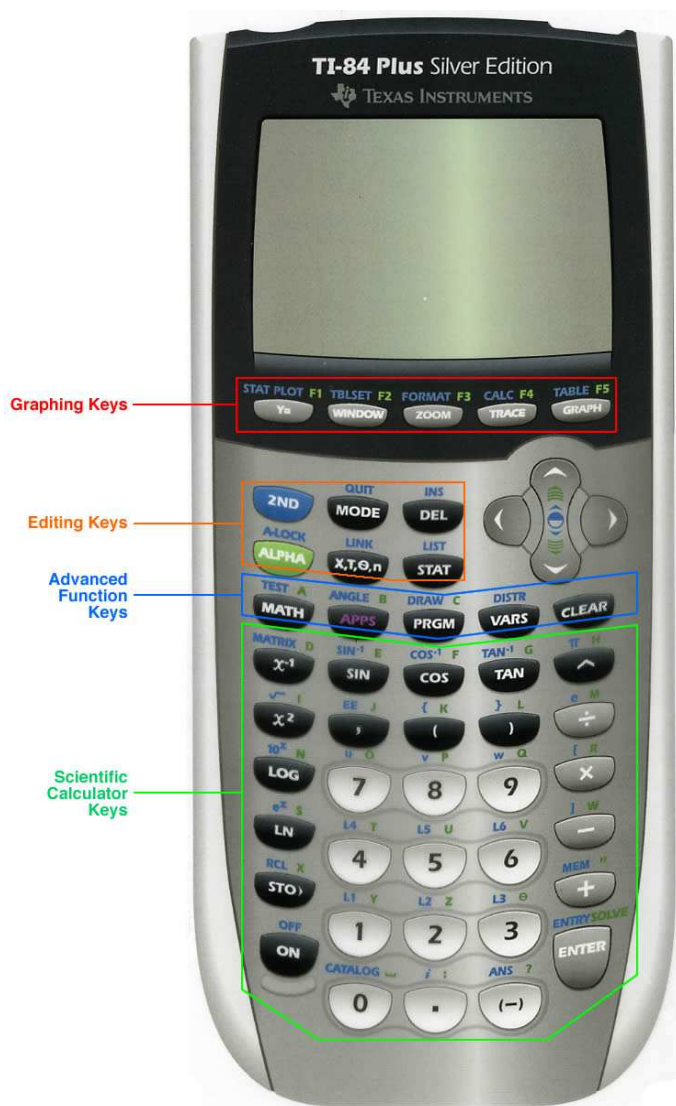
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The Basics: Characteristics of the TI-83+ & TI-84+



HOME SCREEN: This is where most calculations will take place. To access the home screen at any time-press **2nd QUIT**.

CONTRAST: If your screen is visually too light or too dark, adjust the contrast by pressing **2nd** and **Cursor UP** to darken or **DOWN** to lighten.

KEYPAD: The keys on the TI83 and TI84 have many functions. To access the options above the key use either the **2nd** or **ALPHA** key.

THE EQUALS SIGN: The TI83 & TI84 do not have your traditional = key. The **ENTER** key on the bottom right corner means =.

The Basics: Clearing an Entry or Error

1. If you have entered the wrong number or letter, set the cursor on the error and enter the correct information
2. If you need to delete a number or letter, set the cursor on the error, and press the **DEL** key, located next to the cursor.
3. To erase the entire line, press **CLEAR**, located underneath the cursor, once.
4. To clear the whole screen, press **CLEAR** twice.

EXAMPLE

3 - 6 + 12 =

Let's say your calculator looks like this:

3 + 6 + 12

To fix the problem, press **LEFT CURSOR** until it blinks over the + sign. Then, simply press **DEL** to correct the problem!

The Basics: Inserting a Character

To insert a number or letter, set the cursor on the character to the right and then press 2nd INS (above DEL). You may enter as many characters at that point as you wish without pressing INS again.

EXAMPLE

Enter 2² + 4

Change it to read 21² + 4

Move cursor to "2"

Press: 2nd INS

Press: 1

Press: ENTER

The Basics: Recalling Previous Entries

Sometimes, it may be necessary to recall a previous entry, or modify a calculation. By pressing 2nd ENTER, you can access and edit prior actions.

EXAMPLE:

Suppose you just calculated 13^2 , and you wish to find 13^4 .

PRESS: 2nd ENTER

Move the cursor to the ² position

PRESS: ^ 4

Your calculator should look like this:

13^2	169
13^4	28561

By pressing 2nd ENTER repeatedly; you can recall entries further back.

1. Entering Expressions

Expressions are usually entered as they appear in print. The calculator is programmed to follow the order of operations. The answer will appear on the right side of the screen.

EXAMPLE:

Evaluate $27a - 18b$, for $a=136$ and $b=13$

PRESS: 27 x 136 - 18 x 13 ENTER

$27 * 136 - 18 * 13$
3438

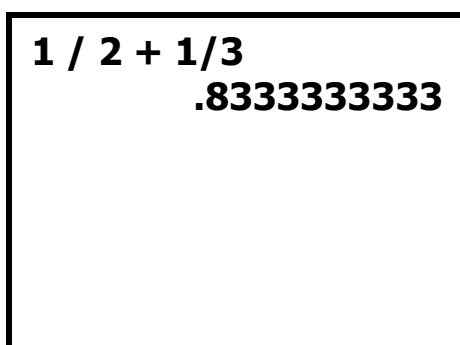
2. Adding & Subtracting Fractions

The TI83 & TI84 can perform operations with fractions. Often, the answer is expressed in decimal form, but it can easily be transformed back into a fraction.

EXAMPLE:

$$\frac{1}{2} + \frac{1}{3} =$$

PRESS: **1** **÷** **2** **+** **1** **÷** **3** **ENTER**



1 / 2 + 1/3
.8333333333

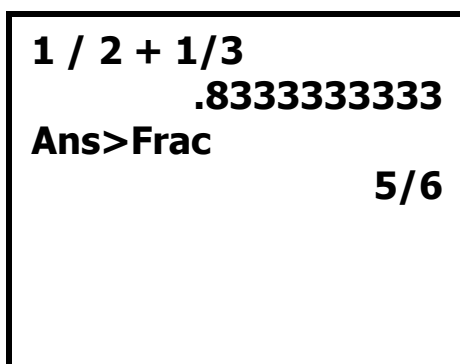
In order to change this answer back into a fraction:

Press: **MATH** key, located underneath the ALPHA key.

Press: **1** to select **>Frac**.

Press: **ENTER** to get the fractional equivalent.

Your screen should now look like this:



1 / 2 + 1/3
.8333333333
Ans>Frac
5/6

So, $\frac{1}{2} + \frac{1}{3} = \frac{5}{6}$

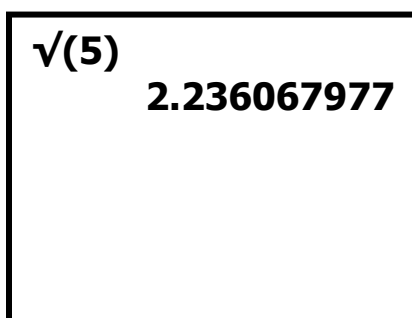
3. Finding and Using the $\sqrt{}$ Key

To approximate square roots on the graphing calculator, you must place the $\sqrt{}$ symbol **before** you enter the number. This is different than many scientific calculators. The $\sqrt{}$ symbol is above the x^2 key and can be accessed by pressing **2nd** **x^2** .

EXAMPLE

Find $\sqrt{5}$.

Press: **2nd** **$\sqrt{}$** **5** **)** **ENTER**

A rectangular box representing a calculator screen. Inside, the text $\sqrt{(5)}$ is displayed on the top line, and the numerical result 2.236067977 is displayed on the line below it.
$$\sqrt{(5)} \\ 2.236067977$$

So, $\sqrt{5} \approx 2.236067977$

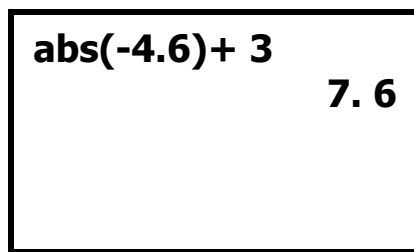
4. Finding and Using the $| |$ (Absolute Value) Key

The graphing calculator uses the notation $\text{abs}()$ to indicate absolute value. This operation is located in the MATH menu, and can be accessed by pressing **MATH**, **RIGHT CURSOR**, and **ENTER** to select $\text{abs}()$.

EXAMPLE

$$|-4.6| + 3 =$$

Press: **MATH** **RIGHT CURSOR** **ENTER** **-4.6** **)** **+** **3** **ENTER**

A rectangular box representing a calculator screen. Inside, the text $\text{abs}(-4.6) + 3$ is displayed on the top line, and the numerical result 7.6 is displayed on the line below it.
$$\text{abs}(-4.6) + 3 \\ 7.6$$

So, $|-4.6| + 3 = 7.6$

5. Powers and the ^ Key

To enter an exponential expression, you must enter the base first followed by the **^** key and then the power.

EXAMPLE

$4^5 =$

PRESS: 4 ^ 5 ENTER

6. Using the correct negative sign

On the TI83 & TI84, you may notice 2 negative signs. Don't worry; your calculator is not broken!

The **– sign**, located in the right column, is the subtraction sign. You use it for mathematical operations like $7 - 6$ and $34 - 45$.

The **(-) sign**, located to the left of the enter key, is the negative sign. It goes in front of a number to negate it. -4 would be entered by pressing **(-)** then **4**.

This may take some time to get used to. If your calculator shows **ERR: SYNTAX** after you press enter, you have probably used the wrong sign!

EXAMPLE

-5+3-6= should be entered as:

(-) 5 + 3 - 6 ENTER

$-5 + 3 - 6$	-8
--------------	------

So, $-5 + 3 - 6 = -8$

7. Using Parentheses Correctly

On the TI83 & TI84, grouping symbols, like the fraction bar, must be replaced by parentheses. This is true for both numerical and algebraic expressions.

EXAMPLE:

$$\frac{11(8-6) + 4 \times 2}{2^3 + 2} =$$

To enter this on the calculator:

PRESS: (11 (8 - 6) + 4 x 2) ÷ ((2 ^ 3) + 2) **ENTER**

*****Note:** Parentheses can be tricky- when in doubt, put parentheses around everything!

8. Evaluating Expressions using the TABLE function

The TI83 & TI84 have a table feature that enables the calculator to evaluate a variable expression for different x values.

EXAMPLE

Evaluate $4x+3-x^2$ for $x = 0,1,2,3$

PRESS: **Y=** and enter the equation using the **x,T,θ,n** to for x.

PRESS: 2nd Tblset (above window key)

Make sure: TblStart=0, ΔTbl=1 and Indpnt. and Depend. are set to auto.

PRESS: 2nd Table (above graph key)

Your screen should look like this:

X	Y₁	
0	3	
1	6	
2	7	
3	6	
4	3	

9. Scientific Notation

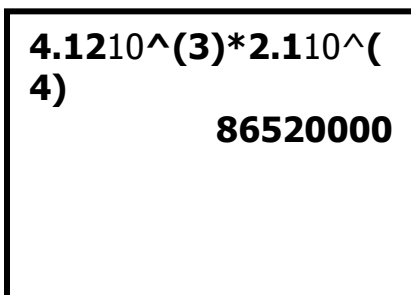
The calculator can perform operations using scientific notation. You can use either the **10^x** key or the **EE** key for this.

EXAMPLE

$$(4.12 \times 10^3)(2.1 \times 10^4) =$$

Option1- Use 10^x key.

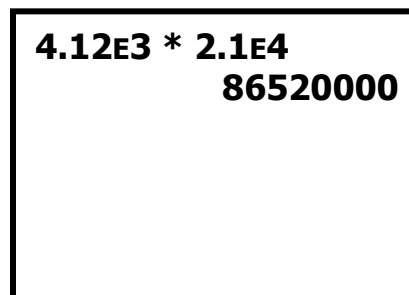
Your calculator should look like this:



4.1210^(3)*2.110^(4)
86520000

Option2- Use EE key

Your calculator should look like this:



4.12E3 * 2.1E4
86520000

10. Entering Linear Equations using Y= key

To graph an equation on the TI83 & TI84, the equation must be in Y= form. Once the equation is in the proper form, the equation can be graphed easily.

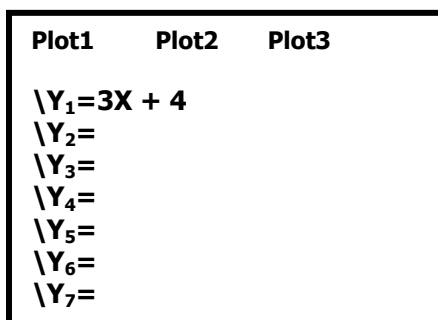
EXAMPLE

Graph $y=3x+4$ on your calculator

PRESS: **Y=** and then enter equation.

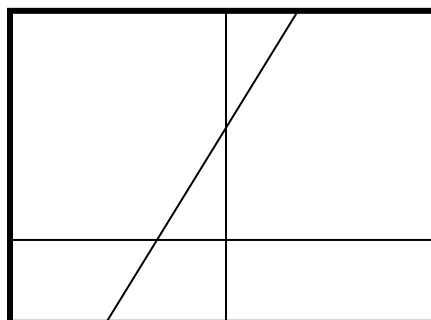
PRESS: **ZOOM** **6** (Standard)

...and then you'll have your graph!



Plot1 Plot2 Plot3
|Y1=3X + 4
|Y2=
|Y3=
|Y4=
|Y5=
|Y6=
|Y7=

Press:
GRAPH



EXAMPLE

Graph $2x+4y=8$ on your calculator

Solving for Y produces the equation $y= -\frac{1}{2}x + 2$, so that is what needs to be entered on the Y= screen.

This may take some practice, but ultimately using the graphing utility will help you greatly!

11. WINDOW and ZOOM: What do they mean and how do I use them?

The WINDOW key, allows you to zoom in and out on your graph. It's similar to a camera lens. For convenience, there are several fixed ZOOM functions, as well as the WINDOW key, which allows you to set your own X and Y parameters.

Press: **WINDOW**

Your screen should look like this →

WINDOW
Xmin = -15
Xmax = 20
Xscl = 5
Ymin = -10
Ymax = 10
Yscl = 1
Xres = 1

This screen allows you to set maximum and minimum values on your axes. The **Xscl** and **Yscl** key sets the way the calculator counts each axis. The window above is set from $[-15, 20]$ on the x axis, counted off by 5s. The y axis is set from $[-10, 10]$, counted off by 1s. Press the GRAPH key to see the axes.

In order to see how the zoom functions manipulate the window, lets enter the equation $y=x^2 + 4x - 4$ into the calculator on the Y= screen.

ZOOM- Standard

PRESS: **ZOOM 6**

This sets your window from -10 to 10 on both the X and Y axis. Many of the graphs you encounter in this course will fit into this window.

ZOOM- In

Press: **ZOOM 2 ENTER**

If the graph is small and hard to see in the standard window, you may want to try to zoom in. This will shrink the window and make your graph seem bigger.

ZOOM- Out

Press: **ZOOM** **3** **ENTER**

If the graph is too large for the window, and you cannot see all that you're looking for- try zooming out. This will make the window larger, and the graph will appear smaller

*****NOTE**: You can zoom in and out as many times as necessary to view your graph.

12. Using the TRACE key to Evaluate

One way to evaluate a graph at a specific point is to use the TRACE key.

EXAMPLE

Evaluate $y=3x-8$ for $x = 2$

PRESS: **Y=**

Enter the equation.

PRESS: **ZOOM** **6**

View graph in standard window.

PRESS: **TRACE**

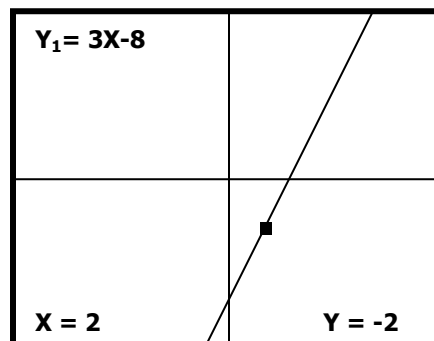
Enter the number you wish to evaluate for

PRESS: **ENTER**

The bottom of the screen will show the corresponding y value.

Your calculator should look like this:

So, at $x = 2$, $y = -2$ is the solution.



13. Solving Quadratic Equations using ZERO function

The graphing calculator allows us to solve quadratic equations without factoring! In order to do this you must use the option called ZERO in the 2nd Calc Menu.

EXAMPLE

Solve: $y = x^2 + 5x - 6$

PRESS: **Y=**

Enter the equation

PRESS: **ZOOM** **6**

View the window, is it appropriate? If not, zoom in or out.

PRESS: **2nd** **CALC** (above TRACE) **2**(for ZERO)

****This next step can get a little tricky, but with practice it will become more natural. Follow the parabola from left to right- just like you would draw it.*

Use the ◀ and ▶ keys to move the cursor through the graph.

For Left Bound - Move the cursor to the left of the x-intercept point.

Press **ENTER**

For Right Bound - Move the cursor to the right of the x-intercept point.

Press **ENTER**

The calculator will now ask for a Guess - just press **ENTER**

Record the result. In this case it is (-6,0).

Now, we must repeat the steps for the 2nd intercept.

For Left Bound - Move the cursor to the left of the x-intercept point.

Press **ENTER**

For Right Bound - Move the cursor to the right of the x-intercept point.

Press **ENTER**

The calculator will now ask for a Guess - just press **ENTER**

Record the result. In this case it is (1,0).

So, the solutions are $x = -6$ and 1

14. Solving Quadratic Equations using A TABLE

Graph your function by using the appropriate window size by

zooming in **ZOOM 2 ENTER** or zooming out **ZOOM 3 ENTER**

Now set up your table by pressing **2nd** followed by **WINDOW**

(*Always choose the same value of X min-Tblstart- “value of x-min”. Make sure $\Delta Tbl=1$)

Now press **2nd** followed by **GRAPH**

Under **Y₁** scroll down until you get a value of **0**

The x value will be your first answer. Repeat these steps as many times as necessary to see all other x-intercepts on your graph.

EXAMPLE

Solve: $y = x^2 + 5x - 6$

PRESS: **Y=**

Enter the equation

PRESS: **ZOOM 6**

View the window, is it appropriate? If not, zoom in or out.

From the graph you will know how many x-intercepts you have. In this example there are 2 x-intercepts, therefore you should have 2 answers.

PRESS: **WINDOW**

Copy the value of Xmin

Xmin = -10

PRESS: **2nd WINDOW**

Set up the table:

TblStart = -10

$\Delta Tbl=1$

PRESS: 2nd GRAPH

View the table. Under **Y₁** scroll down until you get a value of **0**, copy the X value which is $X = -6$. Since we have 2 solutions, therefore keep scrolling down under **Y₁** until you get to the second **0**, copy the X value which is $X = 1$.

So, the solutions are $x = -6$ and 1

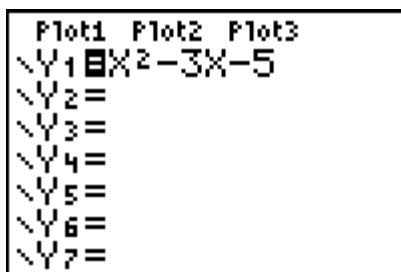
15. Maximum and Minimum value of a Quadratic Equation

In this section, you will be instructed step-by-step to find the maximum or the minimum point of a quadratic equation.

EXAMPLE

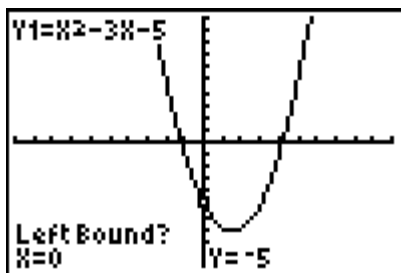
Find the maximum or the minimum value of the function: $f(X) = X^2 - 3X - 5$.

1. PRESS: **Y=** and enter the equation into **Y₁**

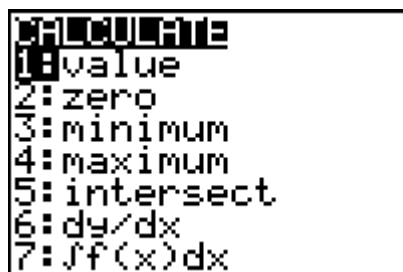


```
Plot1 Plot2 Plot3
Y1= X^2-3X-5
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
```

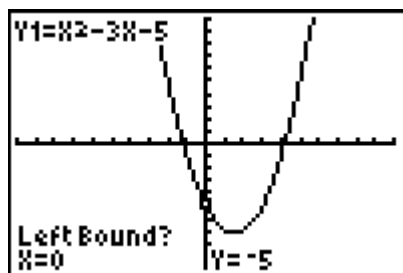
2. PRESS: **GRAPH** to see a full picture of the graph. Make sure that you see the turning point. If you can not see the turning point, zoom in or out.



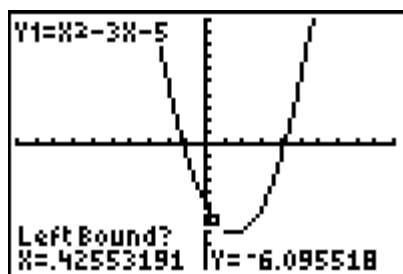
3. From the graph, find if there is a minimum value or a maximum value. If the graph is concaved up, then there is a minimum value. If the graph is concaved down, then there is a maximum value. In this example, there is a minimum value. To find the minimum value:
PRESS **2nd Trace** to activate the **CALC** menu.



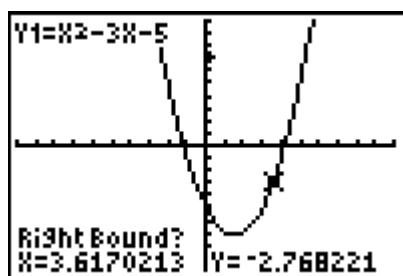
4. PRESS: **3** for **minimum**. If you have a maximum value, you have to PRESS: 4 for maximum.



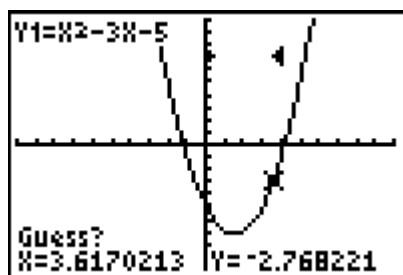
5. The calculator will say **Left Bound?** Use the arrow keys to move the cursor to a point left of the minimum point. PRESS the ENTER key.



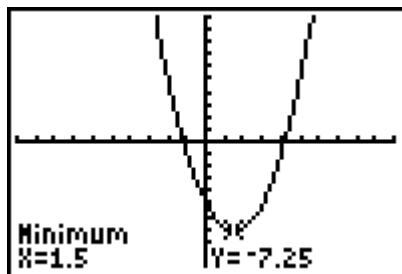
6. The calculator will say Right Bound? Move the cursor to a point to the right of the minimum point. PRESS the ENTER key.



7. The calculator will say Guess? PRESS the ENTER key one last time.



8. The coordinates of the minimum point are displayed at the bottom of the screen. In this example, the minimum value of Y is -7.25 and the minimum value occurs when X is 1.5.



9. Your final answer is: $X = 1.5$ $Y = -7.5$.

16. Solving Systems of Equations using INTERSECT

Your graphing calculator can be used to solve systems of equations, provided you solve each equation for y. Their solution can then be calculated using the INTERSECT option in the CALC menu.

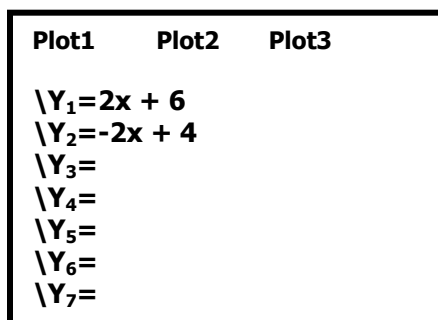
EXAMPLE

Solve the following system of equations:

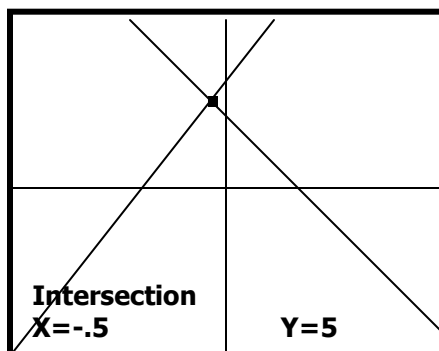
$$Y=2x+6$$

$$2x+y=4$$

1. In order to solve this system, the second equation must be solved for y. Subtracting $2x$ from each side produces the equation $y = -2x + 4$.
2. PRESS: **Y=** and enter the first equation in Y_1 and the second in Y_2 .

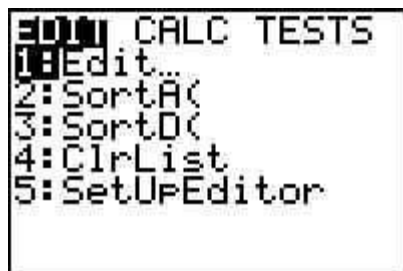


3. PRESS: **ZOOM** **6** and check to make sure you have an appropriate window.
4. To find the solution, PRESS: **2nd** **CALC** **5** (INTERSECT)
5. The calculator will say *first curve?* Move the cursor until it is on top of the intersection point. PRESS: **ENTER**
6. The calculator will say *second curve?* Move the cursor until it is on top of the intersection point. PRESS: **ENTER**
7. PRESS: **ENTER** when the calculator says *guess?*
8. Record the intersection point. In this case it is $(-1/2, 5)$.



17. Plotting Points

1. PRESS **STAT**



2. PRESS: **ENTER** or **1** to see the EDIT screen

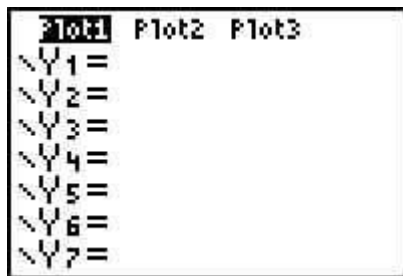
L1	L2	L3	1
████████	-----	-----	
L1(1) =			

3. If there is data, clear it by highlighting **L1**, Press **CLEAR** and hit **ENTER**. Repeat this step to clear all the data in the other lists.
4. ENTER: **x-values** in **L1** and **y-values** in **L2**, make sure to press **ENTER** after each number.

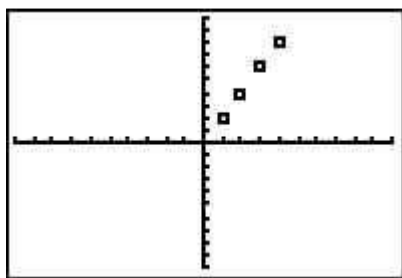
L1	L2	L3	2
1	2		
2	4		
3	6		
4	8		

L2(5) =

5. PRESS: **Y=**
6. HIGHLIGHT: **Plot1** and Press **ENTER**. Make sure that **Plot1** is highlighted.



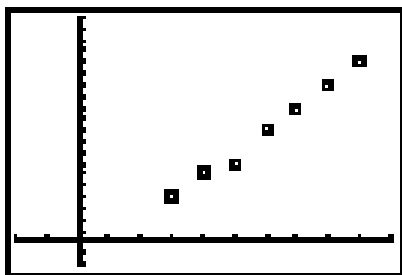
7. PRESS: **ZOOM 9**, the window will display all the points that you entered.



18. Linear Regression

1. Enter data into **L1** and **L2**. (See Section 17. Plotting points)

L1	L2	L3	3
3	4		
5	6		
7	7		
9	10		
11	12		
13	14		
15	16		
L3(1)=			



2. PRESS: **STAT** and highlight **CALC**

```
EDIT [2nd] [F5] TESTS
1:1-Var Stats
2:2-Var Stats
3:Med-Med
4:LinReg(ax+b)
5:QuadReg
6:CubicReg
7:QuartReg
```

3. CHOOSE: **4:LinReg(ax+b)** and hit **ENTER** to find the best fit line equation for the data points that you entered.

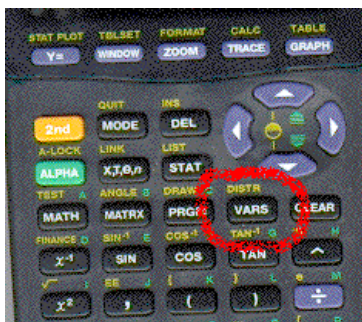
```
LinReg(ax+b) [ENTER]
```

4. PRESS: **ENTER** again to have your line equation.

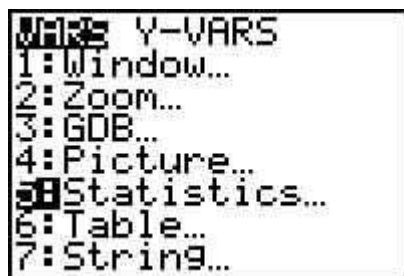
```
LinReg
y=ax+b
a=2.035714286
b=-2.357142857
r^2=.9929706601
r=.9964791318
```

The Line equation is $y = 2.035714286x - 2.357142857$ which is in the form $y = ax+b$

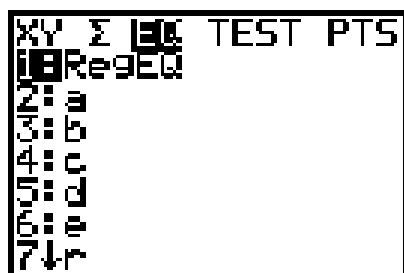
5. To copy the model equation into **Y=** so that you could graph the equation,
GO TO: **Y=** and clear **Y1**.
6. PRESS: **VARS** key



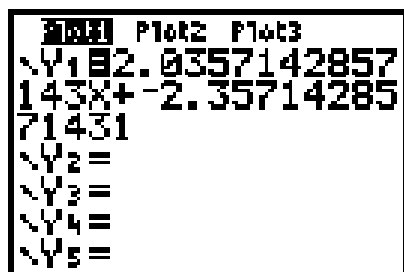
7. PRESS: **5:Statistics**



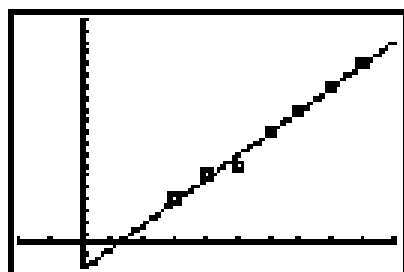
8. Move the cursor to highlight **EQ**



9. PRESS: **ENTER** and the model is placed into **Y1**



10. PRESS: **GRAPH** to see the graph of your model with the data points.



19. Trigonometry: Converting Angles

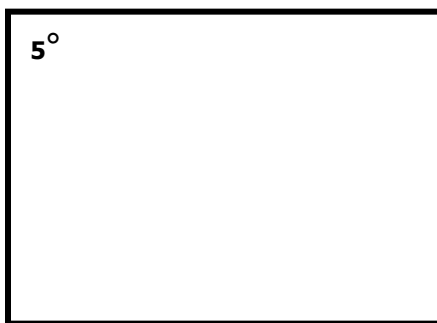
The calculator can convert angles in Degree, Minutes, and Seconds (D°M'S") notation to decimal degree form and vice-versa.

Converting from (D°M'S") Notation to Decimal Degree Form:

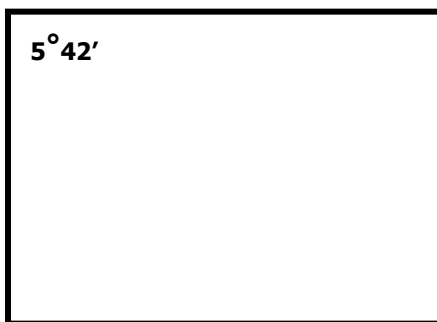
EXAMPLE

Convert 5°42'30" to decimal degree form.

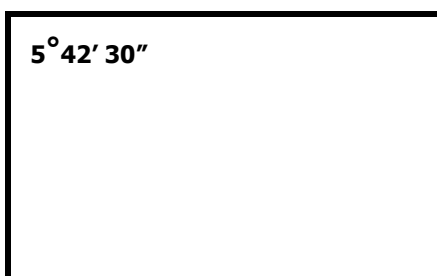
1. PRESS: **MODE**. Make sure that **Degree is highlighted**. If not highlighted, move to Degree and press **ENTER**.
2. Return to the main screen. Enter the number of degrees first. 5. Then PRESS **2nd APPS** (ANGLE) and PRESS **1** for the degrees symbol.



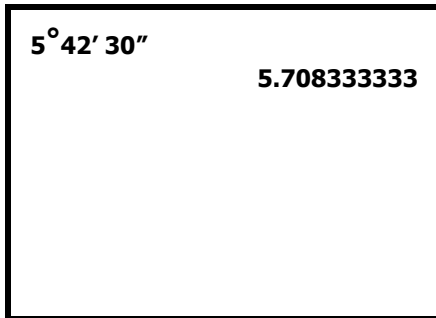
3. Enter the amount of minutes next. 42. Then PRESS **2nd APPS** (ANGLE) and PRESS **2** for the minute's symbol.



4. Enter the amount of seconds next. 30. Then PRESS **APLHA** and PRESS **+** (the addition sign) for the seconds symbol.



5. PRESS **ENTER**.



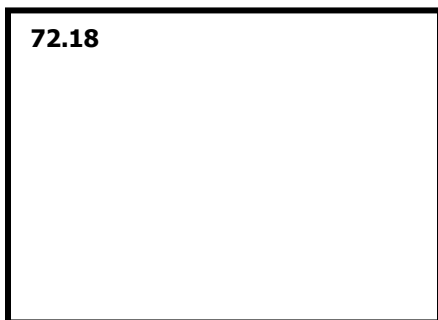
6. Round to the nearest hundredth degree. Your Answer is: $5^{\circ}42'30'' = 5.71^{\circ}$.

Converting Decimal Degree From to (D°M'S") Notation :

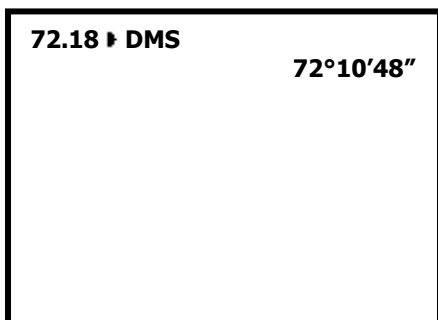
EXAMPLE

Convert 72.18° to D°M'S" notation.

1. PRESS: **MODE**. Make sure that **Degree is highlighted**. If not highlighted, move to Degree and press **ENTER**.
2. To convert decimal degree form to D°M'S" form, we enter 72.18 into the main screen.



3. PRESS **2nd APPS** (ANGLE) and PRESS **4** for DMS. Then PRESS **ENTER**.



4. Your Final Answer is: $72.18^{\circ} = 72^{\circ}10'48''$